Automated Dry Fibre Placement of Complex Geometries

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Objectives

Using an automated manufacturing process such as Automated Dry Fibre Placement (ADFP) for complex geometries can be expensive and time consuming if it is developed with a trial and error approach as it is often the case in industry. This work aims to:

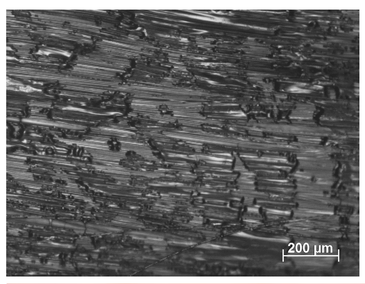
- understand of the fundamental aspects of the ADFP by employing the principle of the pyramid of testing.
- using this understanding to reduce the development time of complex geometries.

This work shows the progression of the fibre volume fraction (V_f) throughout the process, highlighting the impact of the manufacturing process on the preform and laminate quality.

Key Findings

Dry fibre preform

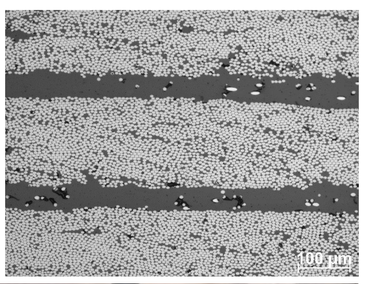
Vacuum infused laminate



The Analytical Hierarchy Process has identified preform V_f as a critical quality metric.

Material

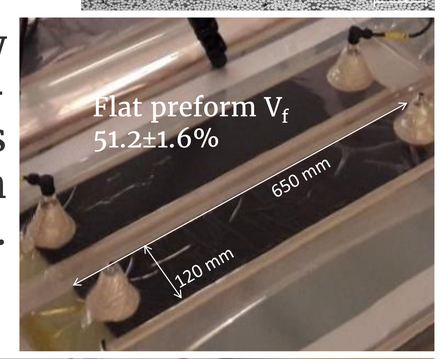
The effect of material constituents on the resin infusion performance was investigated.

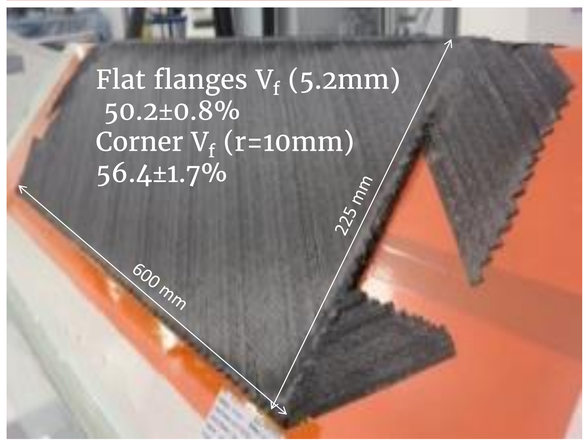


The highest impact process parameter for preform V_f is deposition temperature.

Coupons

The influence of flow direction (in-plane or out-of-plane) on infusion speed is much greater than changes in the preform V_f.

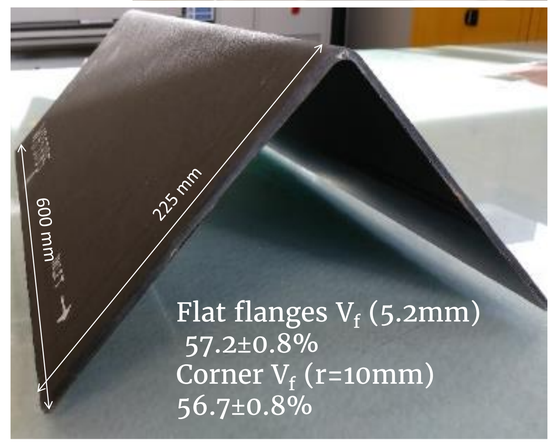


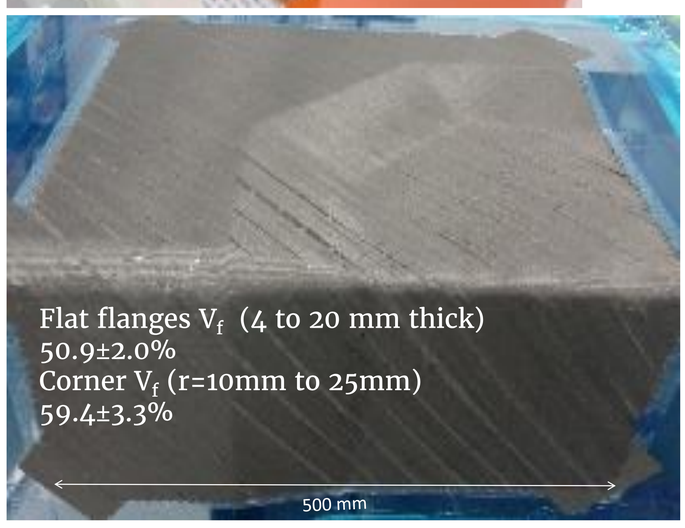


Introducing a geometrical feature increases variability of the preform by decreasing the preform V_f on the apex.

Features

The high temperature vacuum infusion process equalises the difference between the flat and the corner area.

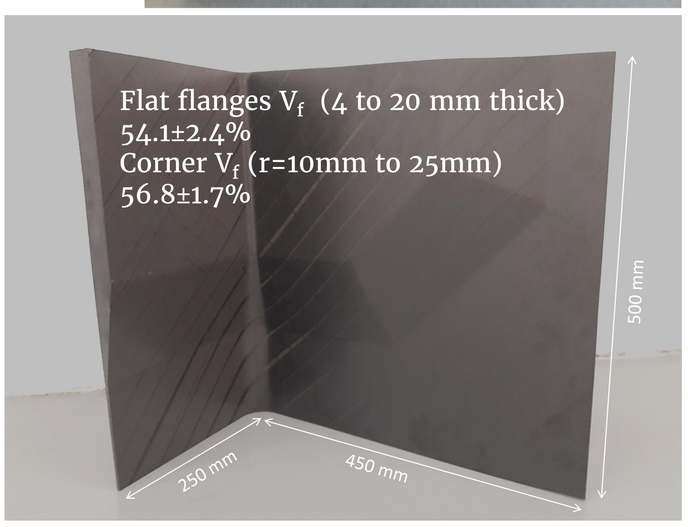




The over-compaction on the apex has increased slightly but overall the same trend as the feature corner occurs.

Component

A similar trend of equalising laminate V_f in comparison to preform V_f occurs at increased complexity.



Evidence of Impact

The developed tools capture the gained knowledge so that it can be applied easily to new material and machine combinations, for example the Analytical Hierarchy Process can be applied to any new material coming to market and benchmark it against existing data. The method and results have been used on various industrial R&D projects at the National Composites Centre, thus allowing a quick turnaround for new configurations in the future.

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